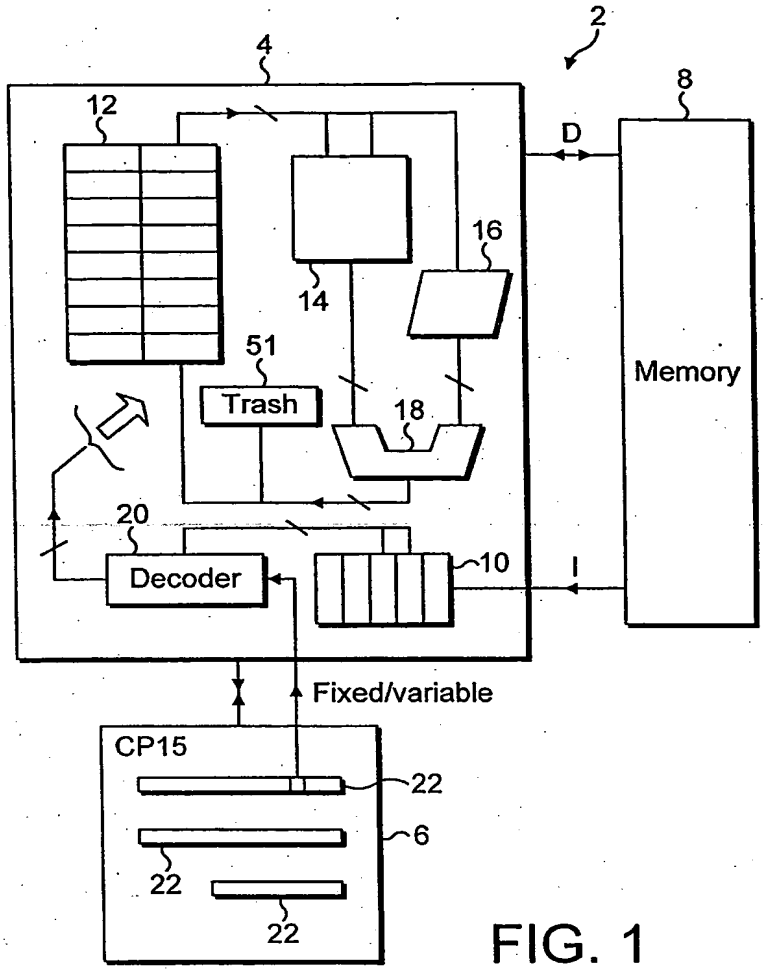

2
4
8
12
D
16
14
51
Trash
18
Memory
20
Decoder
10
Fixed/variable
CP15
22
6
22
22

FIG. 1

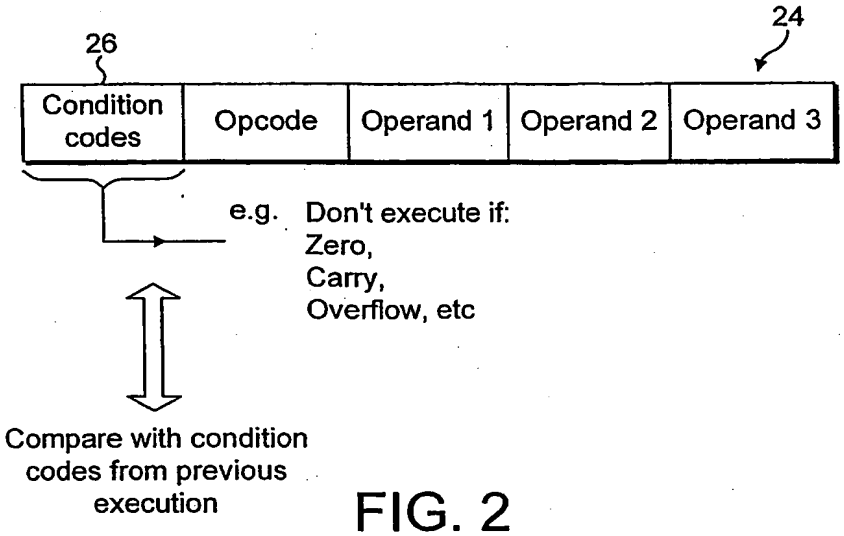

24
26
Condition codes
Opcode
Operand 1
Operand 2
Operand 3
e.g. Don't execute if:
Zero,
Carry,
Overflow, etc
Compare with condition codes from previous execution

FIG. 2

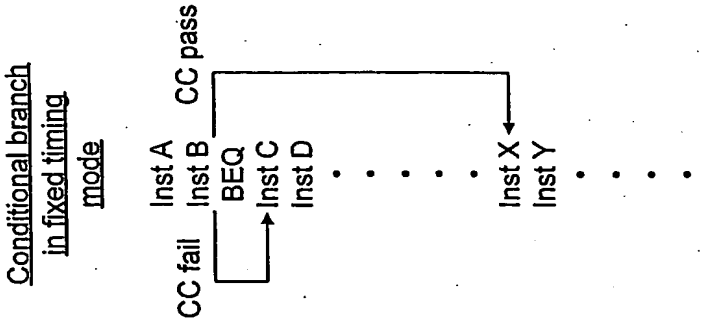

Conditional branch in fixed timing mode
Inst A
Inst B
BEQ
Inst C
Inst D
Inst X
Inst Y
CC pass
CC fail

FIG. 4

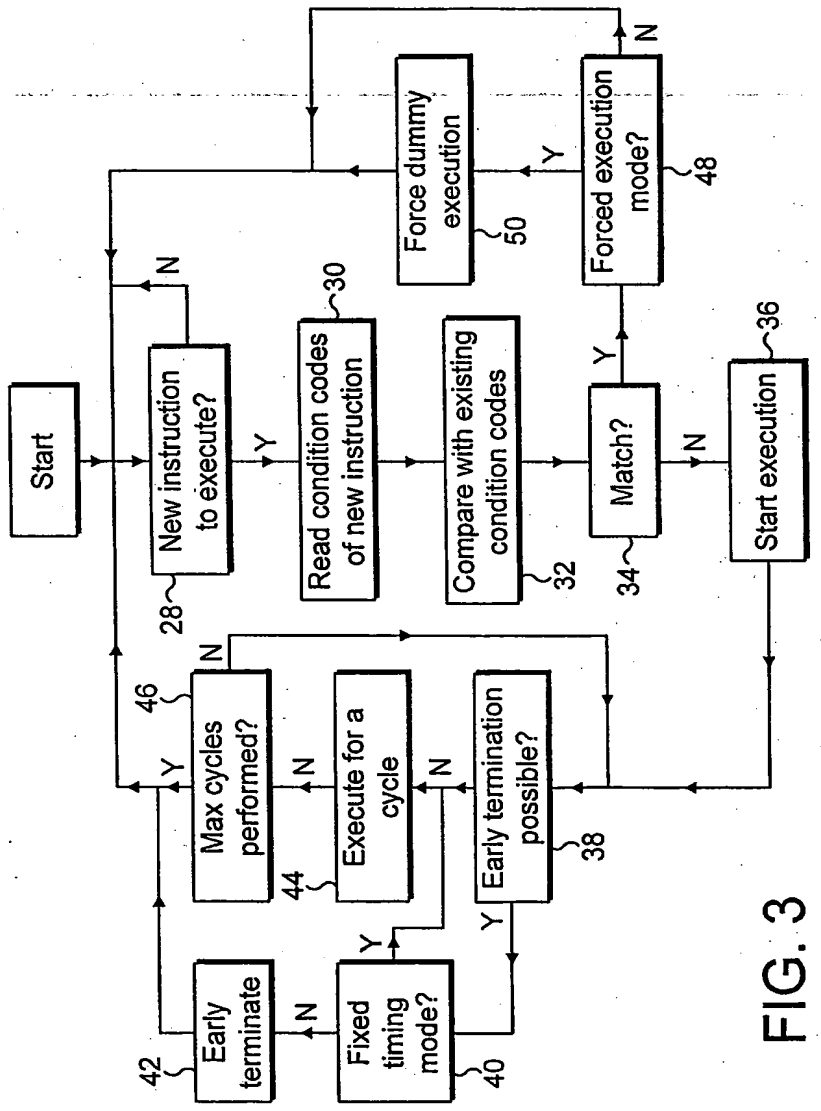

Start
New instruction to execute?
Read condition codes of new instruction
Compare with existing condition codes
Match?
Start execution
Force dummy execution
Forced execution mode?
Max cycles performed?
Execute for a cycle
Early termination possible?
Early terminate
Fixed timing mode?
28
30
32
34
36
38
40
42
44
46
48
50
Y
N

FIG. 3

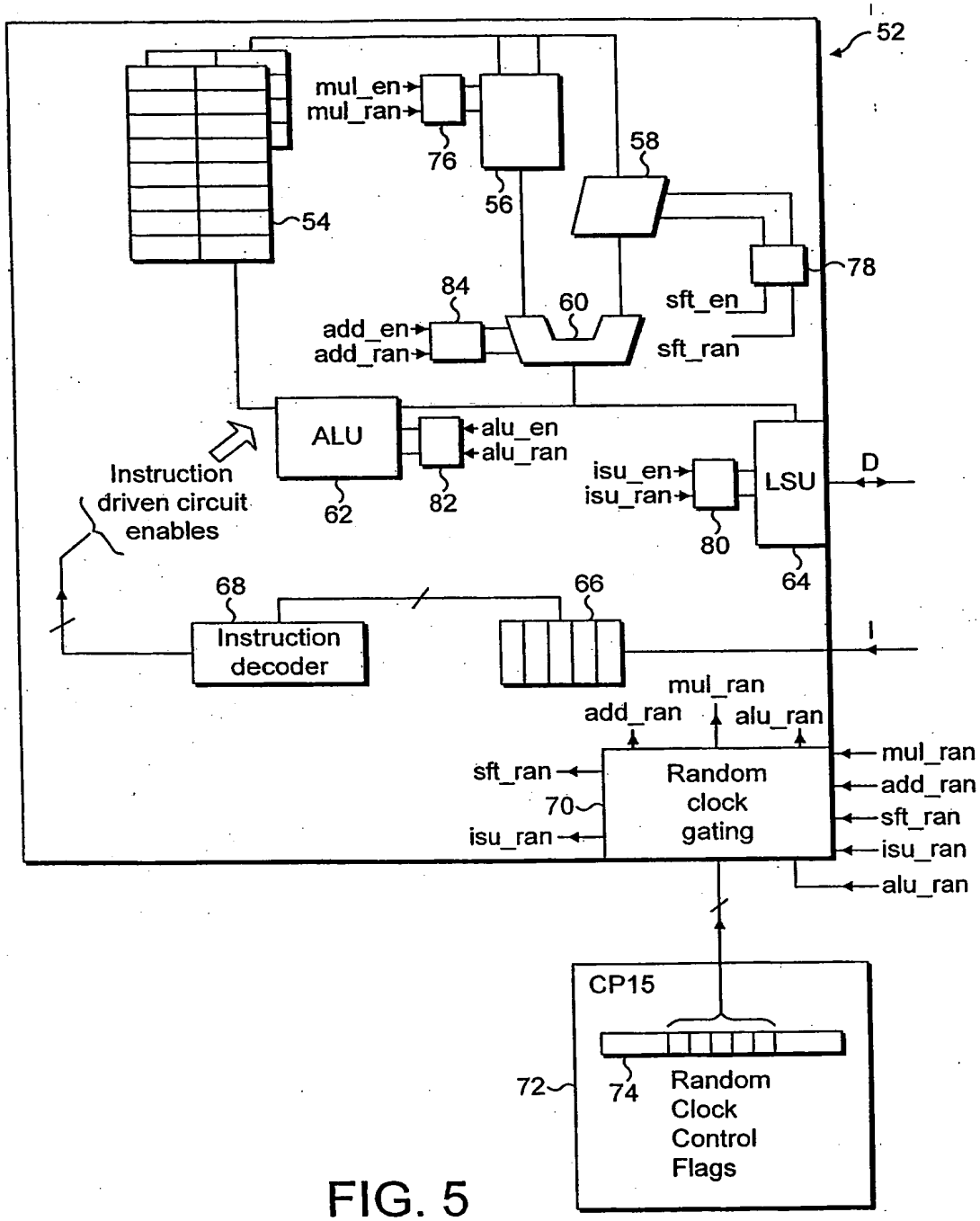

52
mul_en
mul_ran
76
56
58
54
78
84
60
sft_en
add_en
add_ran
sft_ran
ALU
alu_en
alu_ran
Instruction
driven circuit
enables
62
82
isu_en
isu_ran
LSU
D
80
64
68
66
Instruction
decoder
I
mul_ran
add_ran
alu_ran
sft_ran
70
isu_ran
Random
clock
gating
mul_ran
add_ran
sft_ran
isu_ran
alu_ran
CP15
72
74
Random
Clock
Control
Flags

FIG. 5

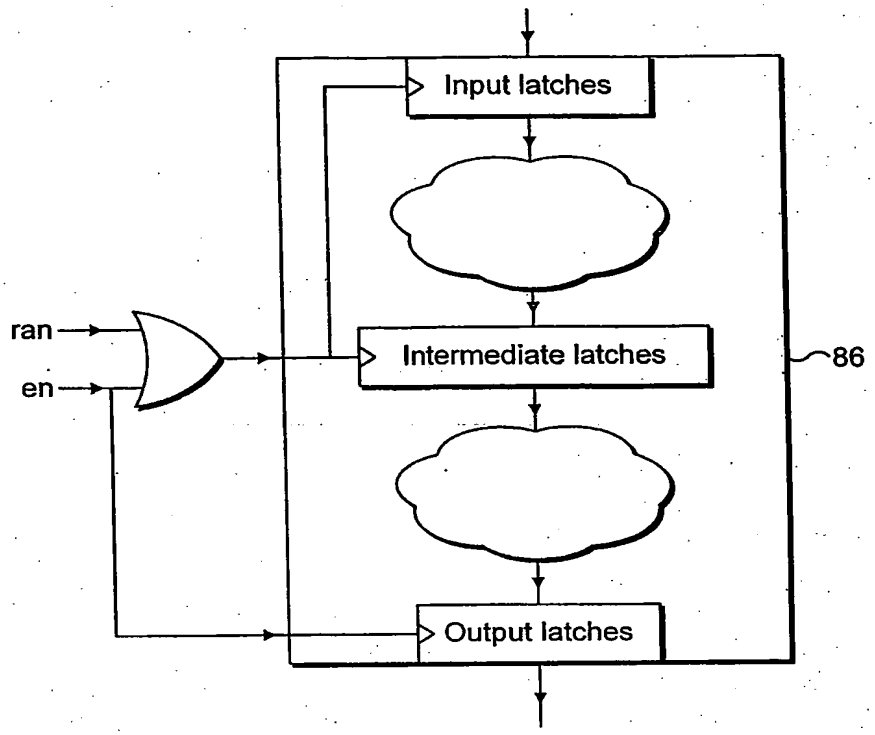

Input latches
ran
en
Intermediate latches
86
Output latches

FIG. 6

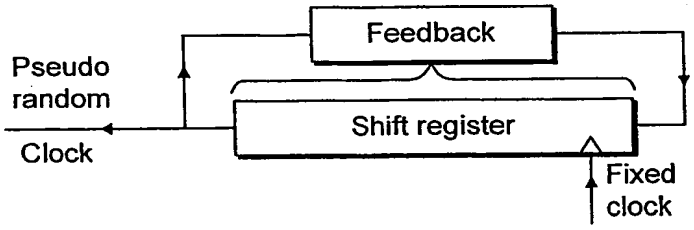

Feedback
Pseudo random
Clock
Shift register
Fixed clock

FIG. 7

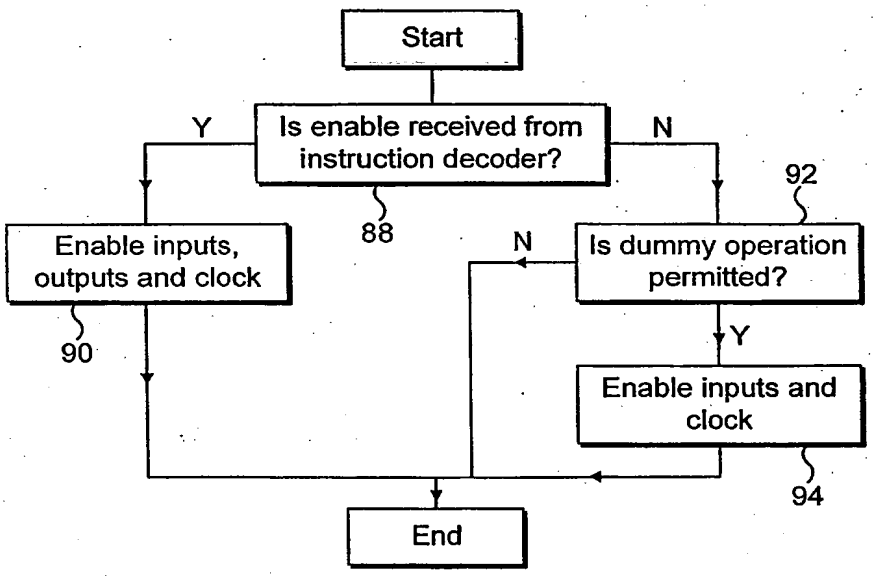

Start
Is enable received from instruction decoder?
Y
N
88
92
Enable inputs, outputs and clock
90
N
Is dummy operation permitted?
Y
Enable inputs and clock
94
End

FIG. 8

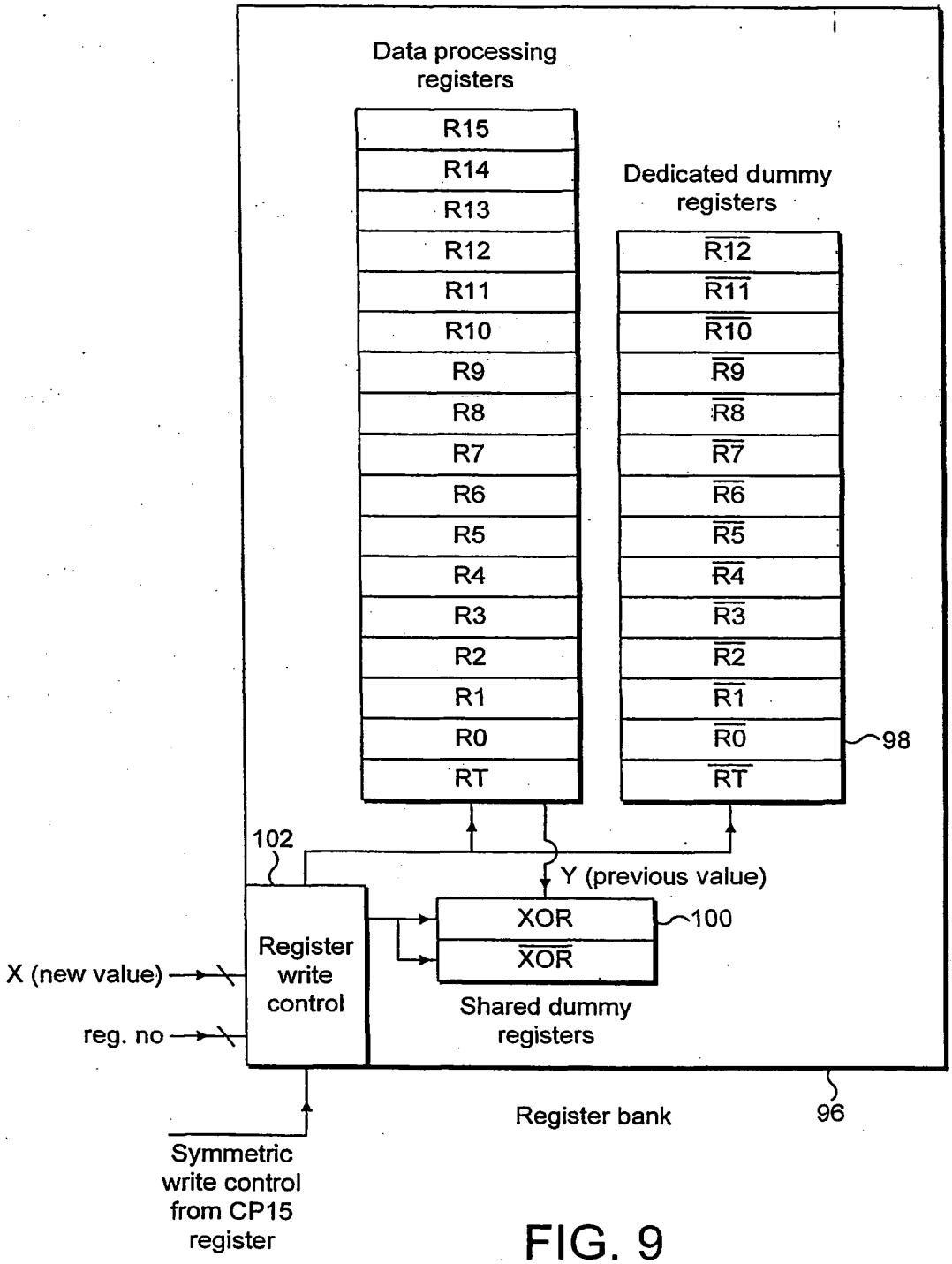

Data processing registers
R15
R14
R13
R12
R11
R10
R9
R8
R7
R6
R5
R4
R3
R2
R1
R0
RT
Dedicated dummy registers
$\overline{R12}$
$\overline{R11}$
$\overline{R10}$
$\overline{R9}$
$\overline{R8}$
$\overline{R7}$
$\overline{R6}$
$\overline{R5}$
$\overline{R4}$
$\overline{R3}$
$\overline{R2}$
$\overline{R1}$
$\overline{R0}$
$\overline{RT}$
98
102
Y (previous value)
XOR
$\overline{XOR}$
100
Shared dummy registers
Register write control
X (new value)
reg. no
Register bank
96
Symmetric write control from CP15 register

FIG. 9

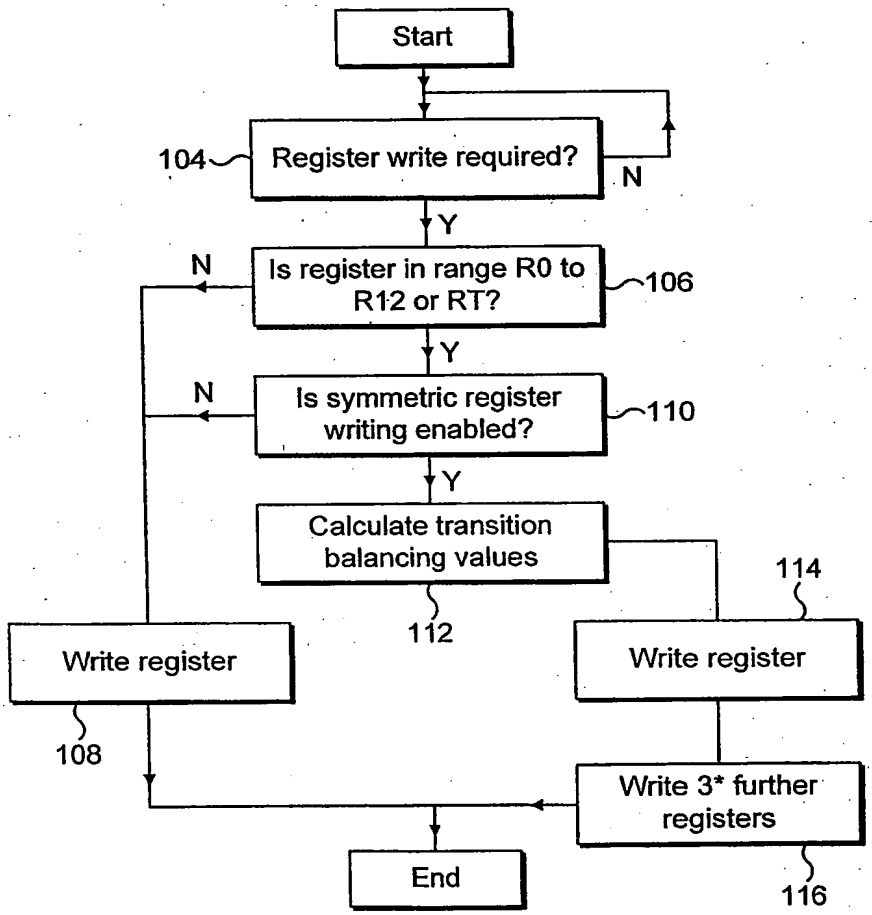
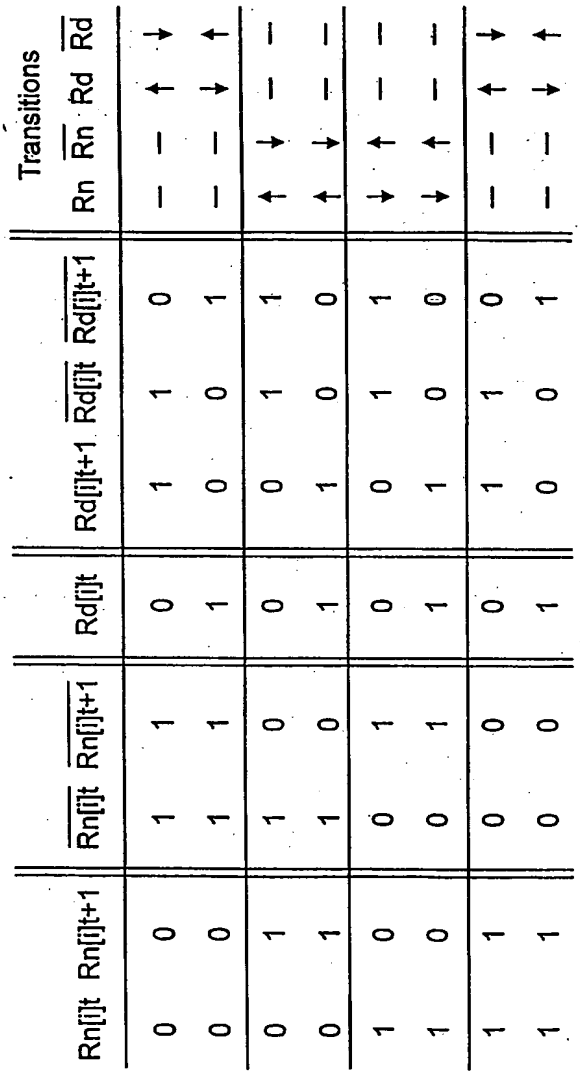

Start
104
Register write required?
N
Y
N
Is register in range R0 to R12 or RT?
106
Y
N
Is symmetric register writing enabled?
110
Y
Calculate transition balancing values
112
114
Write register
Write register
108
Write 3* further registers
End
116

FIG. 10



Rn[i]t	Rn[i]t+1	$\overline{Rn[i]t}$	$\overline{Rn[i]t+1}$	Rd[i]t	Rd[i]t+1	$\overline{Rd[i]t}$	$\overline{Rd[i]t+1}$	Transitions Rn	$\overline{Rn}$	Rd	$\overline{Rd}$
0	0	1	1	0	1	1	0	—	—	↑	↓
0	0	1	1	1	0	0	1	—	—	↓	↑
0	1	1	0	0	0	1	1	↑	↓	—	—
0	1	1	0	1	1	0	0	↑	↓	—	—
1	0	0	1	0	0	1	1	↓	↑	—	—
1	0	0	1	1	1	0	0	↓	↑	—	—
1	1	0	0	0	1	1	0	—	—	↑	↓
1	1	0	0	1	0	0	1	—	—	↓	↑

$$Rd[i]t+1 = \left(\overline{Rn[i]t \text{ XOR } Rn[i]t+1}\right) \text{ XOR } Rd[i]t$$

FIG. 11

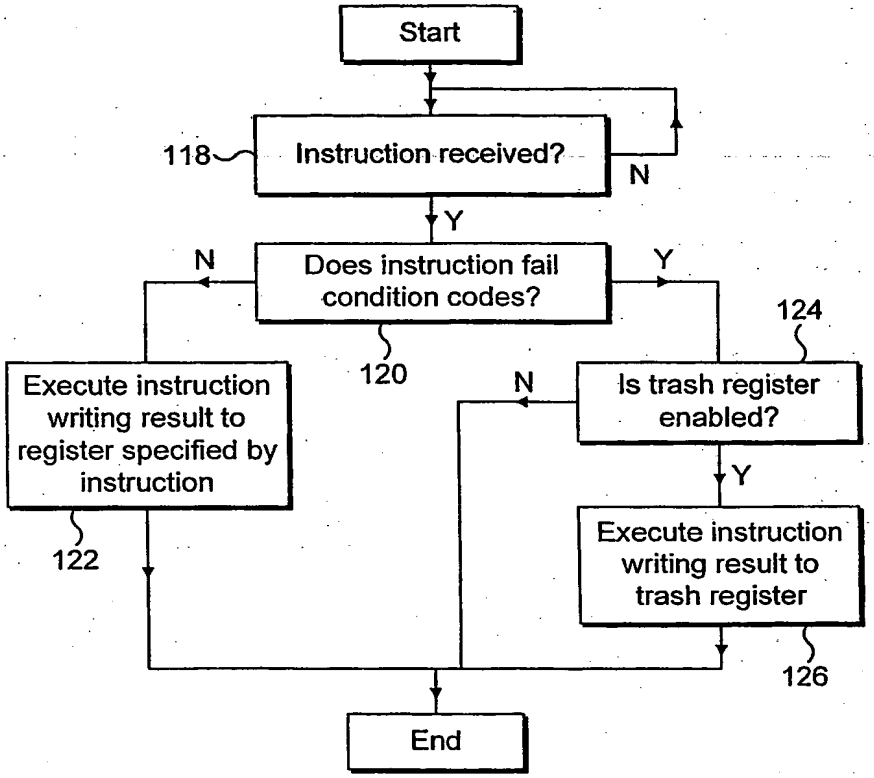

Start
118
Instruction received?
N
Y
N
Does instruction fail condition codes?
Y
120
124
Execute instruction writing result to register specified by instruction
N
Is trash register enabled?
Y
122
Execute instruction writing result to trash register
126
End

FIG. 12

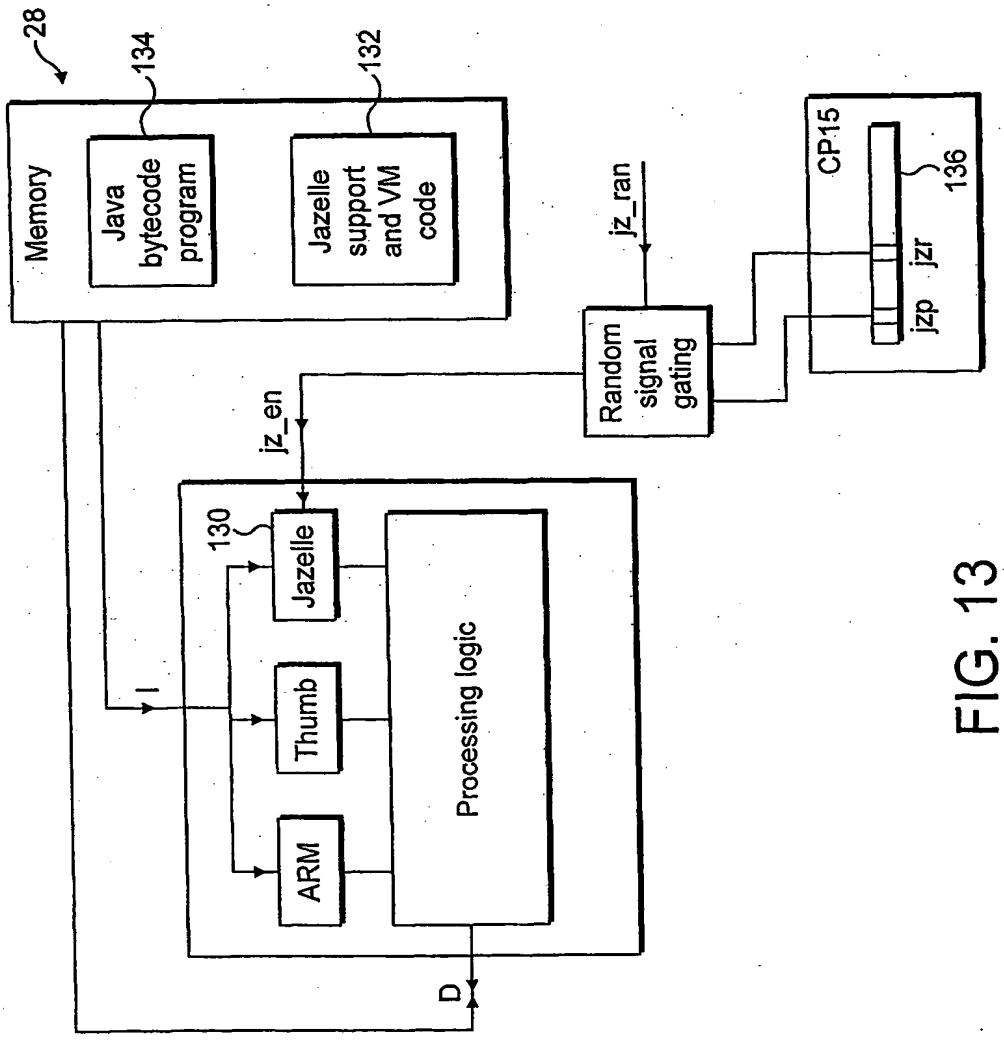

28
134
132
Memory
Java bytecode program
Jazelle support and VM code
jz_ran
CP15
136
jzr
jzp
Random signal gating
jz_en
130
Jazelle
Thumb
ARM
Processing logic
I
D

FIG. 13

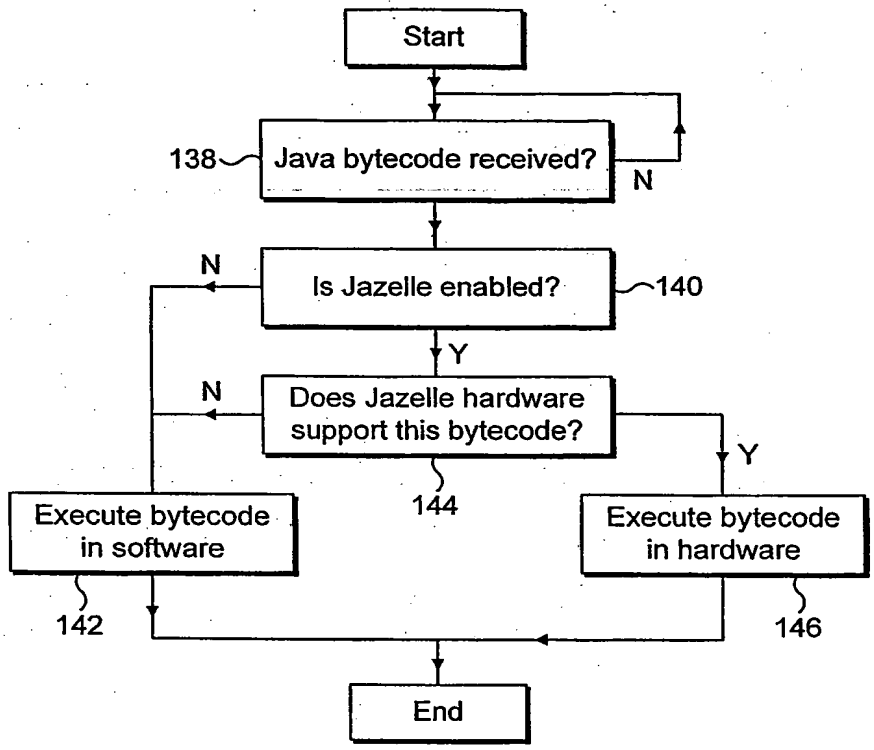

Start
138
Java bytecode received?
N
N
Is Jazelle enabled?
140
Y
N
Does Jazelle hardware support this bytecode?
Y
144
Execute bytecode in software
Execute bytecode in hardware
142
146
End

FIG. 14